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# *Naval Aviation Crew Resource Management (CRM) Initiative*

Human Factors QMB/Training Improvements  
Working Group Brief

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**COMSEACONWINGPAC**

26 July 00

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# *Crew Resource Management (CRM) Initiative*

- **Naval Air Board Human Factors ESC**
  - **Naval Air Board Human Factors QMB**
    - **Training Improvements Working Group**
      - Initiatives to reduce skill-based and judgment errors:
        - **CADS Beta Test** (standardized data collection, crew feedback, and performance measurement)
        - **Integrated CRM** event-based curriculum (emphasis on situational awareness/decision making)
        - **Advanced Flight Instructor skills** (performance assessment/coaching)
        - **Decision Skills Training** (emphasis on critical thinking)

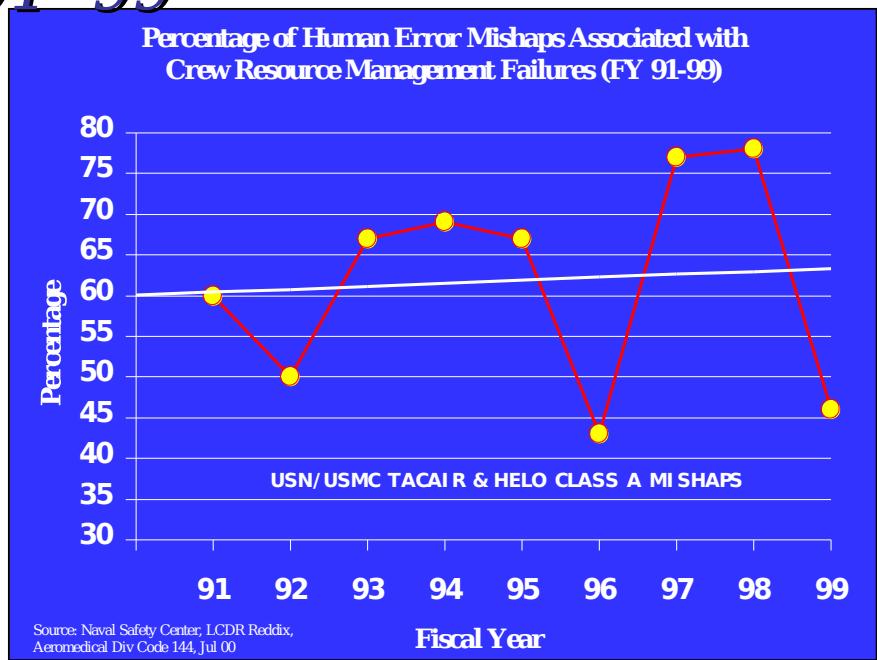
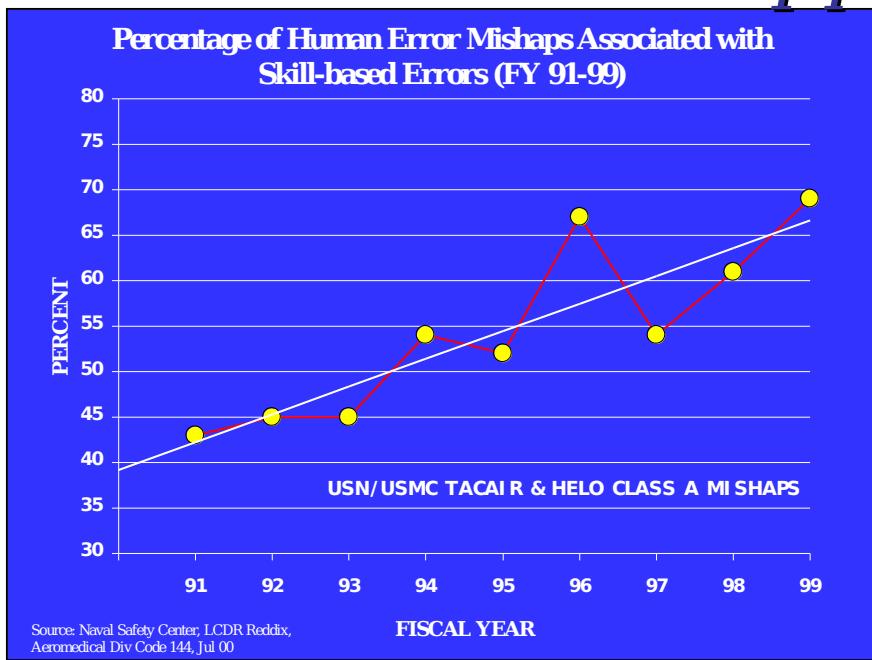
# CRM Goals

- Reduce mishap rate caused by HF & skill-based errors:
  - Provide aircrews with more realistic, defined training experiences and standards
  - Standardized procedures
- Improve mission performance:
  - Measurable evaluation and improved feedback adapted to each type model aircraft across Air Combat Training Continuum
  - Validate and improve effectiveness of Training and Readiness Matrices

# Skill-based & CRM Errors

## *Naval Aviation Mishaps*

*FY 91- 99*



# CRM Elements

- CRM Elements

- Operational Risk Assessment & Management
- Aircraft Flight Control
- Communication Skills
- Decision Processes & Skills
- Situational Awareness
- Tactical and Standard Operating Procedures

- Integrated CRM elements vice stove-piped:

- NATOPS procedures and checklists
- Training curriculum and evaluation

# FAA ACRM Training

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## **Developing Advanced Crew Resource Management (ACRM) Training: A Training Manual**

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Thomas L. Seamster, Deborah A. Boehm-Davis, Robert  
W. Holt, and Kim Schultz

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August 1, 1998



Federal Aviation Administration  
Office of the Chief Scientific and  
Technical Advisor for Human  
Factors, AAR-100

# CRM Initiative

Computer  
Aided  
Performanc  
e  
Assessmen  
t System  
and  
Analysis

NATOPS  
and  
Tactical  
Integratio  
n/  
Instruction  
al Systems  
Design

Instructor  
Training  
and  
Decision  
Skills  
Training

**CHAIN OF COMMAND  
SUPPORT**

# CADS™

- **CADS™ Registered trademark of ER Labs for commercial digital playback system in simulators:**

- COTS technology - digital recording, storage, playback of flight & tactics (VS)
- Beta system at VS-41 (FRS) since 1997
- HSL-41 (FRS) system installed 1998
- Airline beta tests (Northwest, Delta)
- Navy Installs in work (simulators):
  - HSL-40 (Mayport)
  - COMSEACONWINGLANT VAQ 139 (FRS)

# CAPAS/CADS™

## **CAPAS - Computer-Aided Performance Assessment System (Navy version)**

- Mission Need Statement - CNO approved (May 99)
- Operational Requirements Document (ORD)
  - CINCPACFLT endorsed to NAVAIR (Mar 00)
- **Required Capability (Simulator):**
  - Record audio, video & data (flight & tactics)
  - Debrief & evaluation (subjective & objective)
  - Analysis (immediate and long term) (objective)
  - Archive & edit
- ***Potential for aircraft use***

# CAPAS/CADS™ Current Capability

- **Digitally records entire simulator event:**
  - Cockpit, aircraft, flight & tactics (VS) performance data
  - Crew audio and video
  - Aircraft aspect and tactical plot
- **Instructor digitally ‘marks’ places while recording event using Interface Device**
  - Can return instantly to digital marks during debrief, improving fidelity and focus of debriefs
  - Marks become reference for later analysis of CRM performance

VS-41 Debrief Room

CAPAS/CADS™

**Big screen  
display**

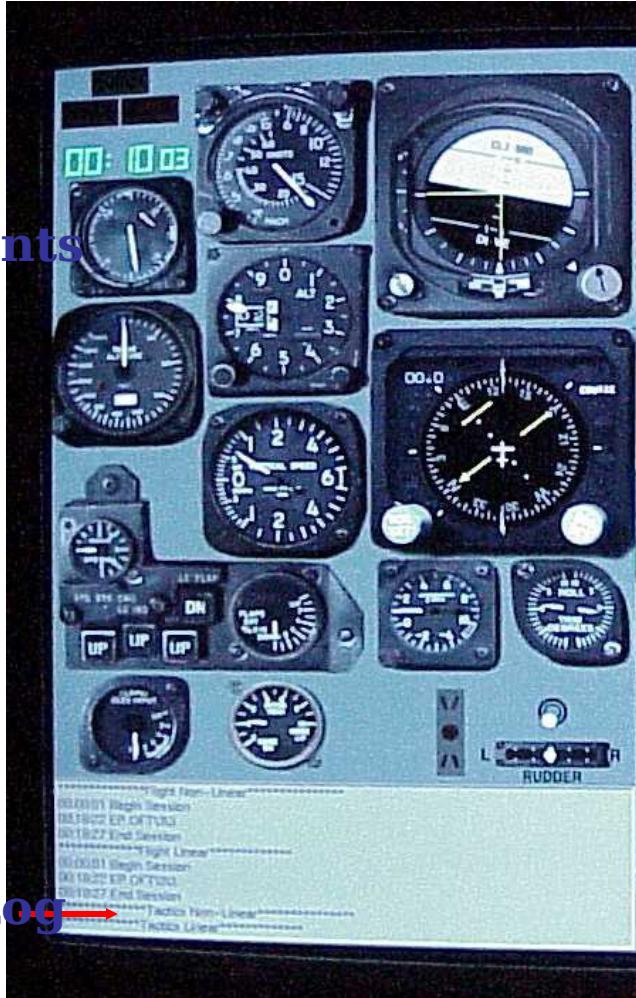


**Monitor & PC**

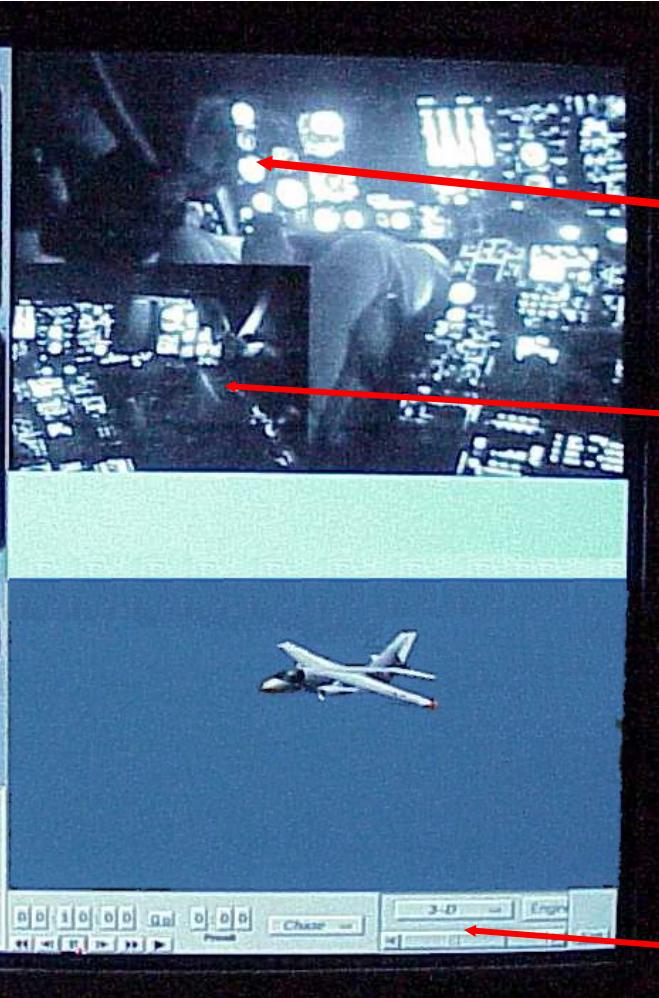


# Sample CAPAS/CADS™ Display

Cockpit Instruments



\* CAPAS = Computer-Aided Performance Assessment



IR  
Cockpit  
Video  
Pilot

COTAC

Views

- Chase  
plane

- Tower

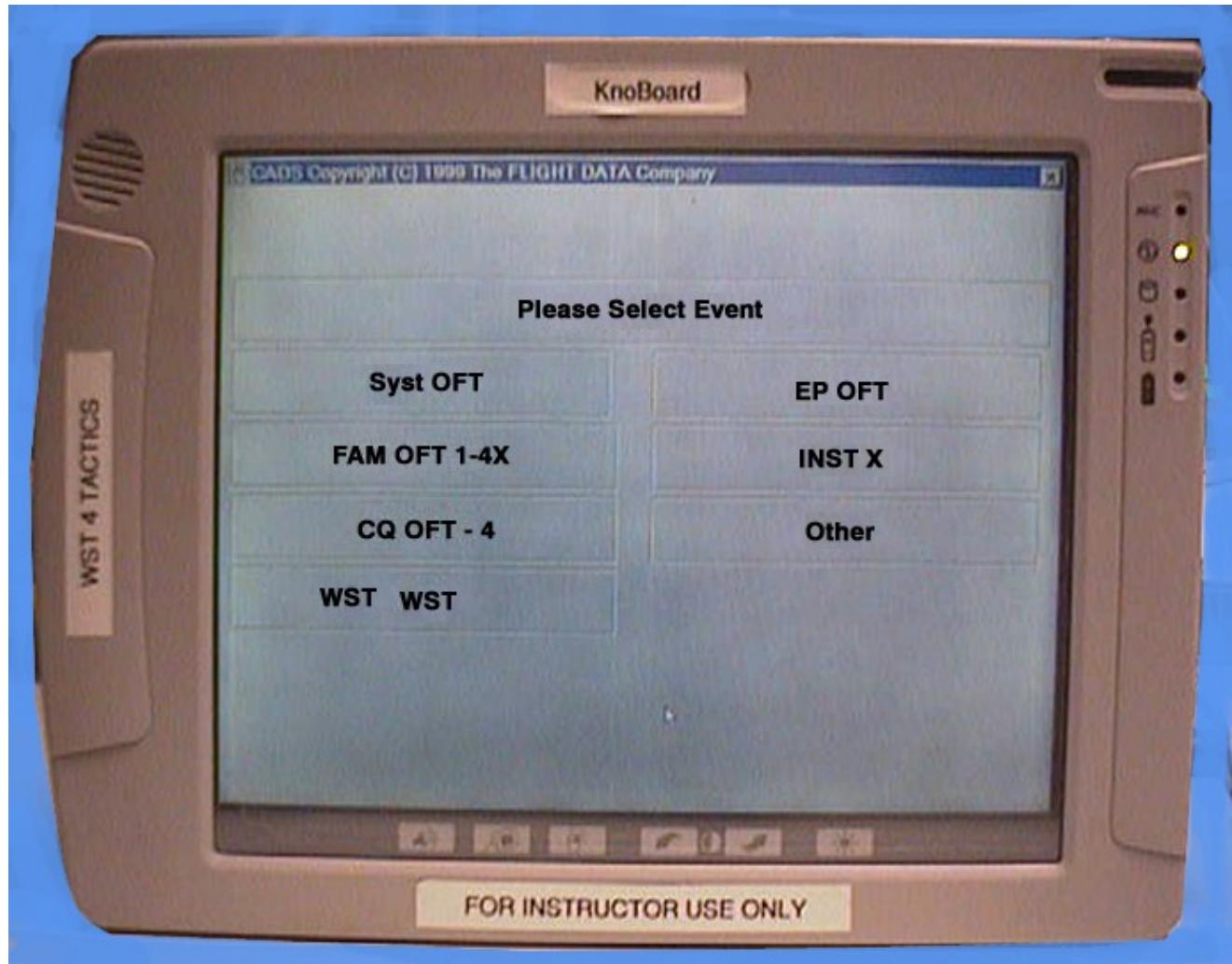
- LSO

- Tactical  
plot

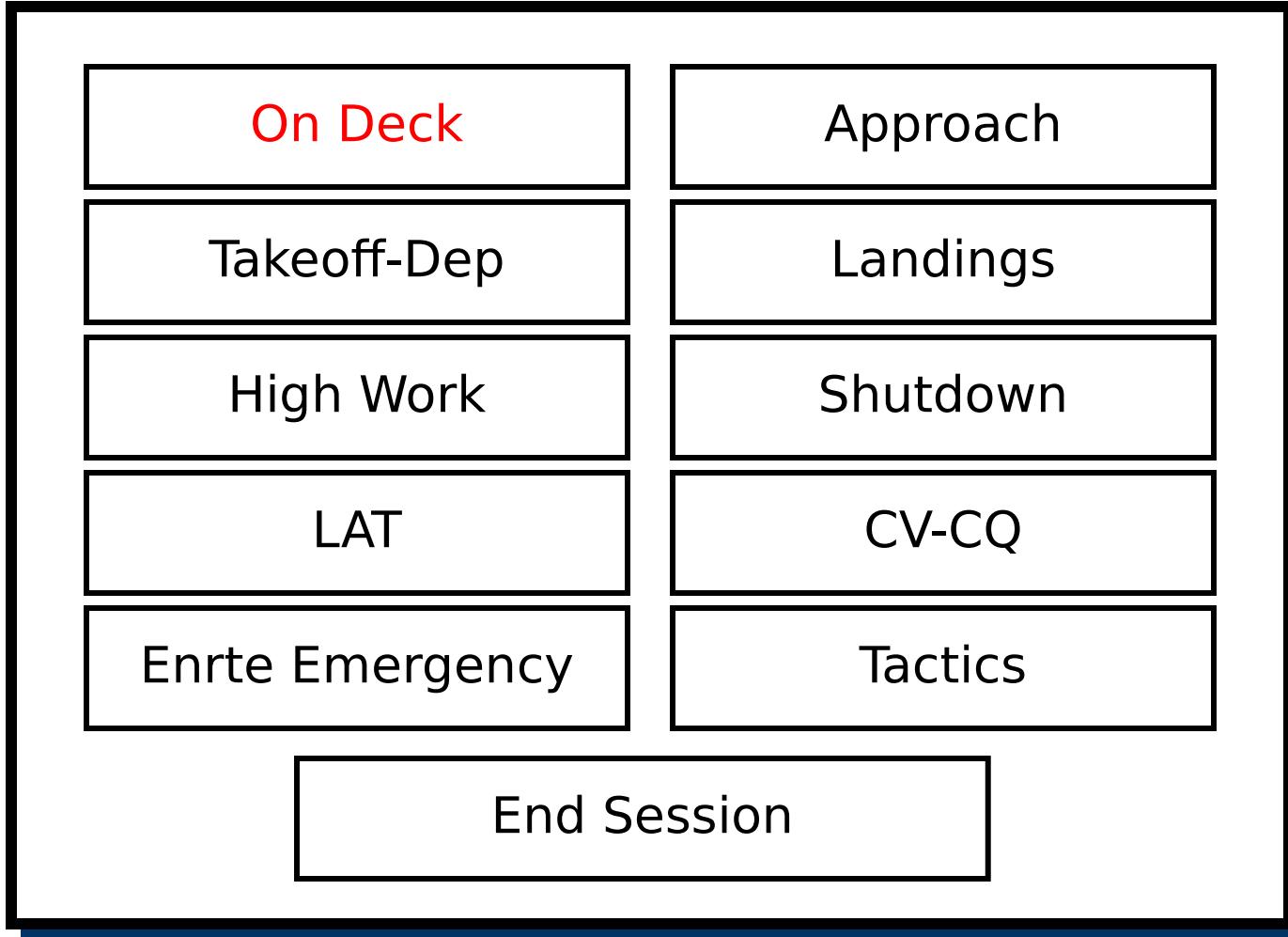
Replay  
controls

# CAPAS/CADS™ Interface Device Example

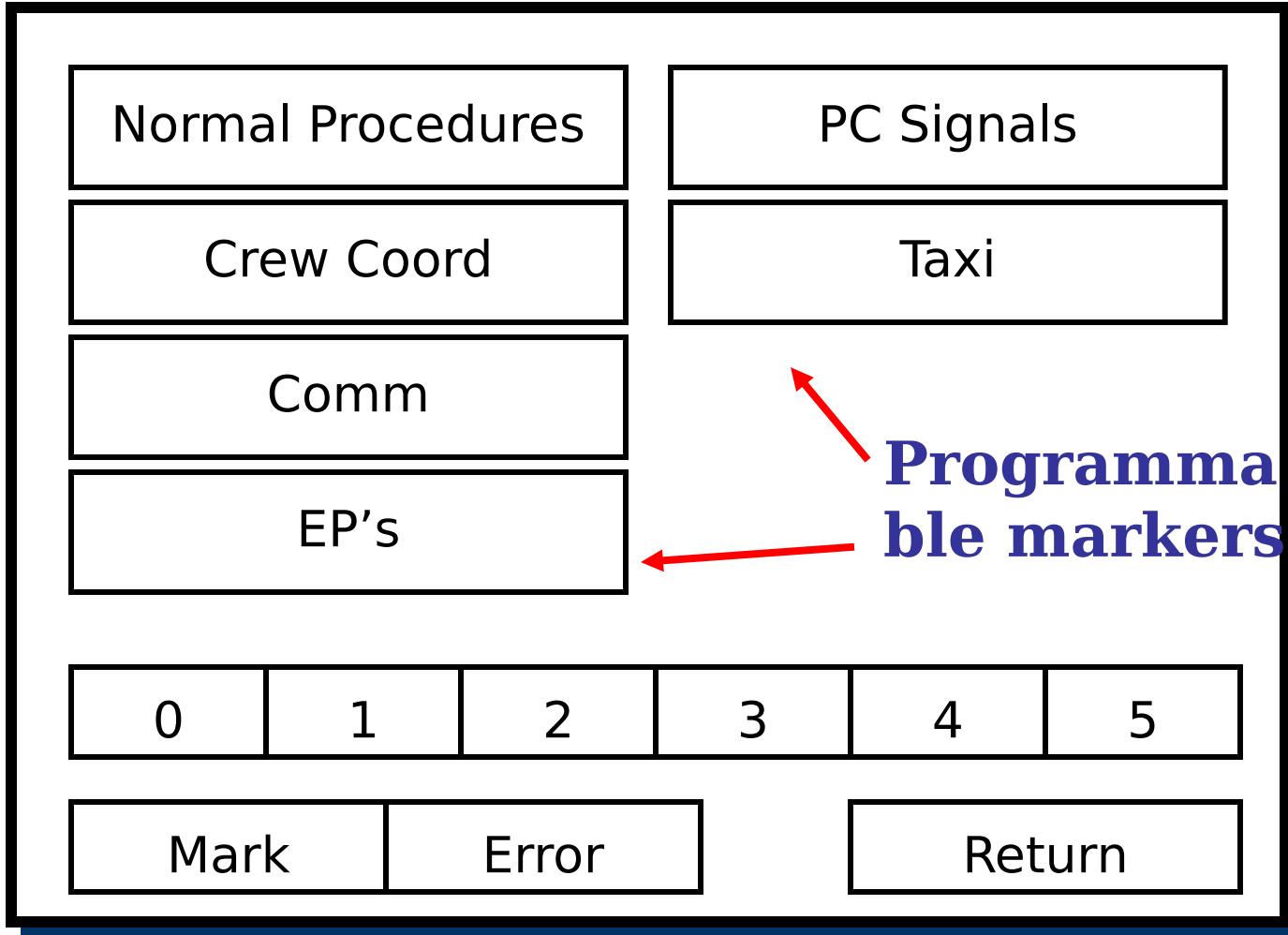
- Hand held or Mounted
- Programmable



# CAPAS/CADS™ Interface Device Example



# Marks within 'On Deck'



# CAPAS Usage at VS-41

- **Used to assist assessment and feedback for 18 of 29 simulator events (62%):**
  - 4 Weapon System Trainers (WST)
  - 9 Operational Flight Trainers (OFT/CQOFT)
  - 5 Tactics and Ordnance Trainers
- **System utility varies significantly with event type**
  - Most useful on CRM-intensive WST and OFT events
  - Not as useful on flight/weapon procedural trainers
- **Beyond the debrief**
  - Instructor training & standardization (“SOD/down” review)
  - Establishing an event file library for student review

# CAPAS Instructor Training at VS-41

- **6+ hours of CAPAS training for IUT's**
  - Human performance (2.5 hr)
  - Debriefing and Grading (3 hrs)
  - CAPAS operation/hands on application (.5 - 1 hr)
- **Recurrent Training Usage - CADS files**
  - Instructor standardization
  - Debrief/analysis of SODs (“downs”) and “gold standards”
  - “What if?” scenarios
  - *Even mundane events will provoke 10-15 min of discussion*

# Planned CAPAS/CADS™ Upgrades

- **Next Steps**

- Incorporate **video crew de-identification** software
- Install Windows-based drag and drop editing capability (**IT-21 compliant**).
- Add capability to **save edited files to CD-ROM/DVD** for use in classroom and stand-alone Computer-Based Training (CBT)
- *Begin routine flight skill and CRM performance data collection and analysis.*

# CAPAS Benefits

- **Student**

- Focused debrief - immediate access to marked learning points
- Details facilitate self-assessment
- Identify and correct deficient skills at earliest point; create individual performance plans
- Access to archive of best/worst aircrew practices (de-identified)

- **Instructor**

- Improved instructor performance
  - Improved standardization
    - Specific evaluation criteria established and used
    - Ensure event objectives covered
    - Evaluate inter-rater reliability in grading
  - Improved use of debrief time
- Establish and archive best instructional practices (de-identified)

# CAPAS Benefits

- **Curriculum**

- Track both individual and group training trends
- Establish/change evaluation & performance standards
- Enhances student/instructor focus on specific knowledge/skill/judgement
  - Identify and eliminate unnecessary objectives
  - More accurate identification of deficiencies
- Incorporate best practices event files throughout curriculum (CBT, instructor training)

# Data Collection and Assessment

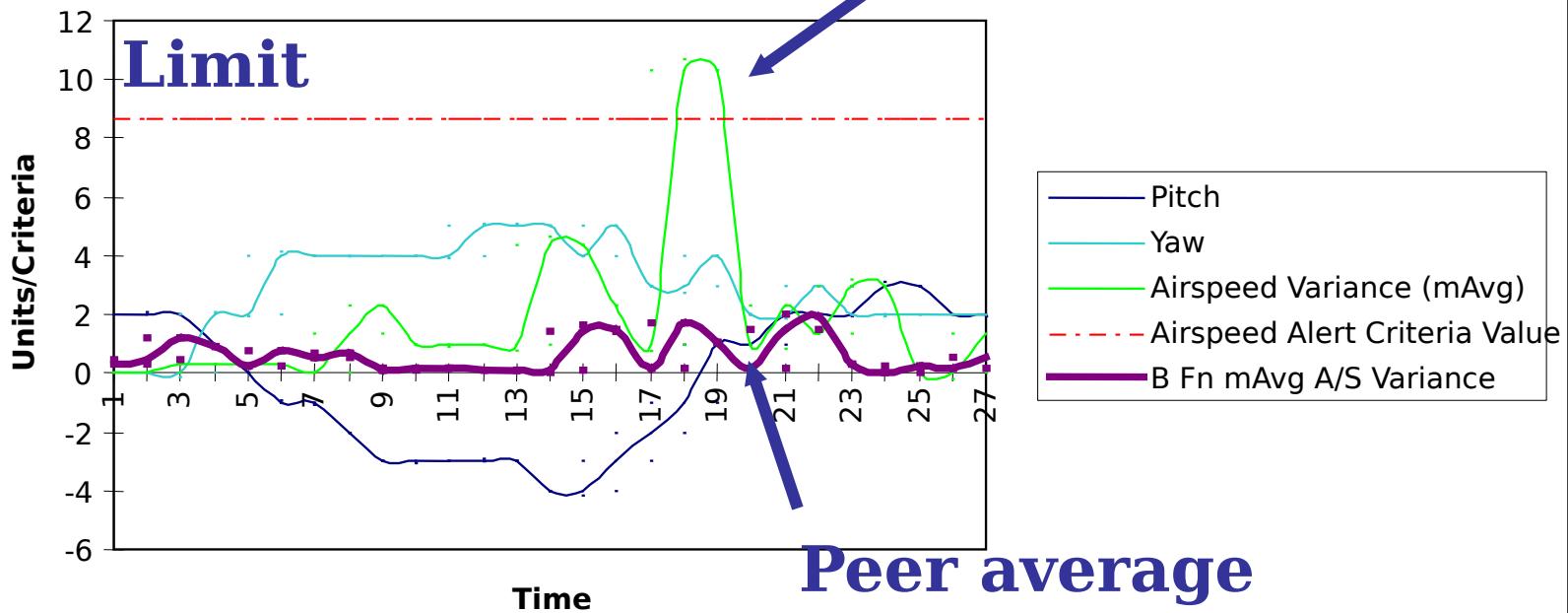
- **Map skill performance against:**
  - Established *standards*
  - Performance of *peers*
  - Previous performance *(self)*

***Analyze training and ops data instead of mishap data***

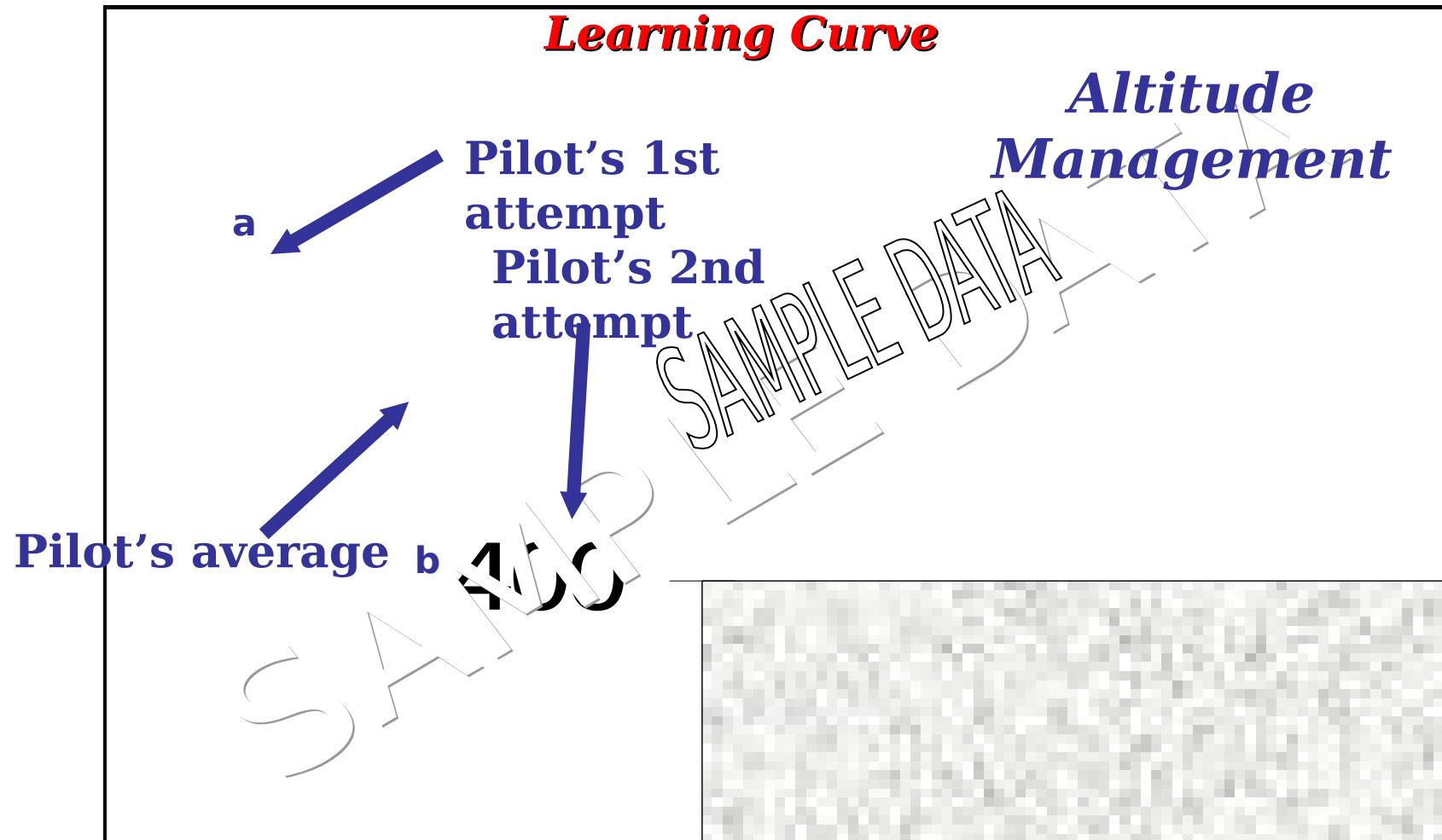
# CAPAS Analysis Single Event

*Airspeed*

## *Sample Data Management* Student



# Performance Analysis



# Data Collection, Assessment & Analysis

- **Aircrews, Instructors, & Training System**

- Provide real-time detailed feedback to aircrews, instructors & training systems
- Objective evaluation
- Diagnose and predict performance
  - Identify behaviors/skill levels that consistently lead to successful mission performance
- Identify rate of skill degradation
- Define underlying/systemic problems that lead to mishaps

- **Analyze training and ops data instead of potential for mishaps**

# ACTC Measurement/Feedback

- **Identify behaviors and skill levels that lead to consistent, successful performance**
- **Identify skill degradation rates**
  - Provides objective measurement for T & R Matrix (periodicity)
- **Map skill development and proficiency to establish objective performance standards**
- **Provide real-time, detailed feedback to aircrews, instructors & training system**

# NATOPS & SOP

- **Will benefit from data gained through current CRM program initiatives:**
  - Identify best crew behaviors/problem areas to:
    - Better define and organize critical elements of NATOPS & SOPs
  - Improved Flight Manuals and Pocket Checklists
    - Human Factors format to reduce crew errors

# NATOPS Examples

## Current version

### OIL SYSTEM MALFUNCTIONS

\*1. Throttle.....Idle; Monitor  
Engine Instruments

*If abnormal indications persist:*

\*2. Throttle.....OFF  
\*3. FIRE pull handle.....Pull  
\*4. Ignition switch.....OFF  
5. Generator switch.....OFF  
6. APU.....Check Altitude,  
Airspeed/Start  
7. APU automatic shutdown.....Disarm  
8. APU GEN switch.....ON  
9. BLEED AIR switch.....OFF  
10. Hydraulic servo (if No. 2).....OFF  
11. Land as soon as practicable.....Refer to  
Single-Engine  
Landing Procedure

#### WARNING

If the oil pressure drops to zero, the  
engine shall be shut down to preclude  
a catastrophic failure, unless safety of  
flight dictates otherwise.

## Proposed new version

### OIL SYSTEM MALFUNCTION

\*1. THROTTLE  
2. ENGINE INSTRUMENTS

- IDLE  
- MONITOR

#### WARNING

If the oil pressure drops to zero, the engine shall be shut down to preclude a catastrophic failure, unless safety of flight dictates otherwise.

*IF ABNORMAL INDICATIONS PERSIST:*

3. THROTTLE - OFF  
4. PRECEED TO NEAREST SUITABLE FIELD FOR LANDING  
5. IMMEDIATE ACTIONS COMPLETE,  
GO TO ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN  
CHECKLIST PAGE [16]

# NATOPS Example

*Proposed new NATOPS procedures that follow-on from those in the new **OIL PRESSURE MALFUNCTION** procedure:*



## ENGINE FAILURE FOLLOW-ON PROCEDURES / APPROACH AND LANDING CHECKLISTS

### **ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN CHECKLIST**

→ **IF ENGINE FAILURE WAS NOT CAUSED BY A MECHANICAL MALFUNCTION OR A GREATER EMERGENCY EXISTS:**

**OR**

**BEFORE AIRSTART / ASSISTED AIRSTART Checklist..PERFORM GO TO PAGE [40]**

→ **IF ENGINE RESTART WILL NOT BE ATTEMPTED OR ENGINE DOES NOT START:**

|  |          |
|--|----------|
| 1. EHP   | - ON     |
| 2. APU   | - CHECK  |
| ALTITUDE / AIRSPEED / START                                |          |
| 3. APU AUTOMATIC SHUTDOWN                                  | - DISARM |
| 4. APU GEN SWITCH  | - ON     |
| 5. <input type="checkbox"/> GENERATOR SWITCH               | - OFF    |
| 6. <input type="checkbox"/> BLEED SWITCH                   | - OFF    |
| 7. <input type="checkbox"/> IGNITION SWITCH                | - OFF    |
| 8. <input type="checkbox"/> HYDRAULIC SERVO (IF #2 ENGINE) | - OFF    |
| 9. LAND AS SOON AS PRACTICABLE                             |          |

→ **IF #1 HYDRAULIC SYSTEM IS OPERABLE:**

**OR**

**10. CHECKLIST COMPLETE, GO TO SINGLE ENGINE APPROACH AND LANDING CHECKLIST PAGE [45]**

→ **IF #1 HYDRAULIC SYSTEM INOPERABLE:**

|  |       |
|--|-------|
| 11. HYDRAULIC SERVO #1   | - OFF |
| 12. CHECKLIST COMPLETE, GO TO SINGLE ENGINE/ #1 HYDRAULIC SYSTEM INOPERABLE APPROACH AND LANDING CHECKLIST PAGE [46] |       |

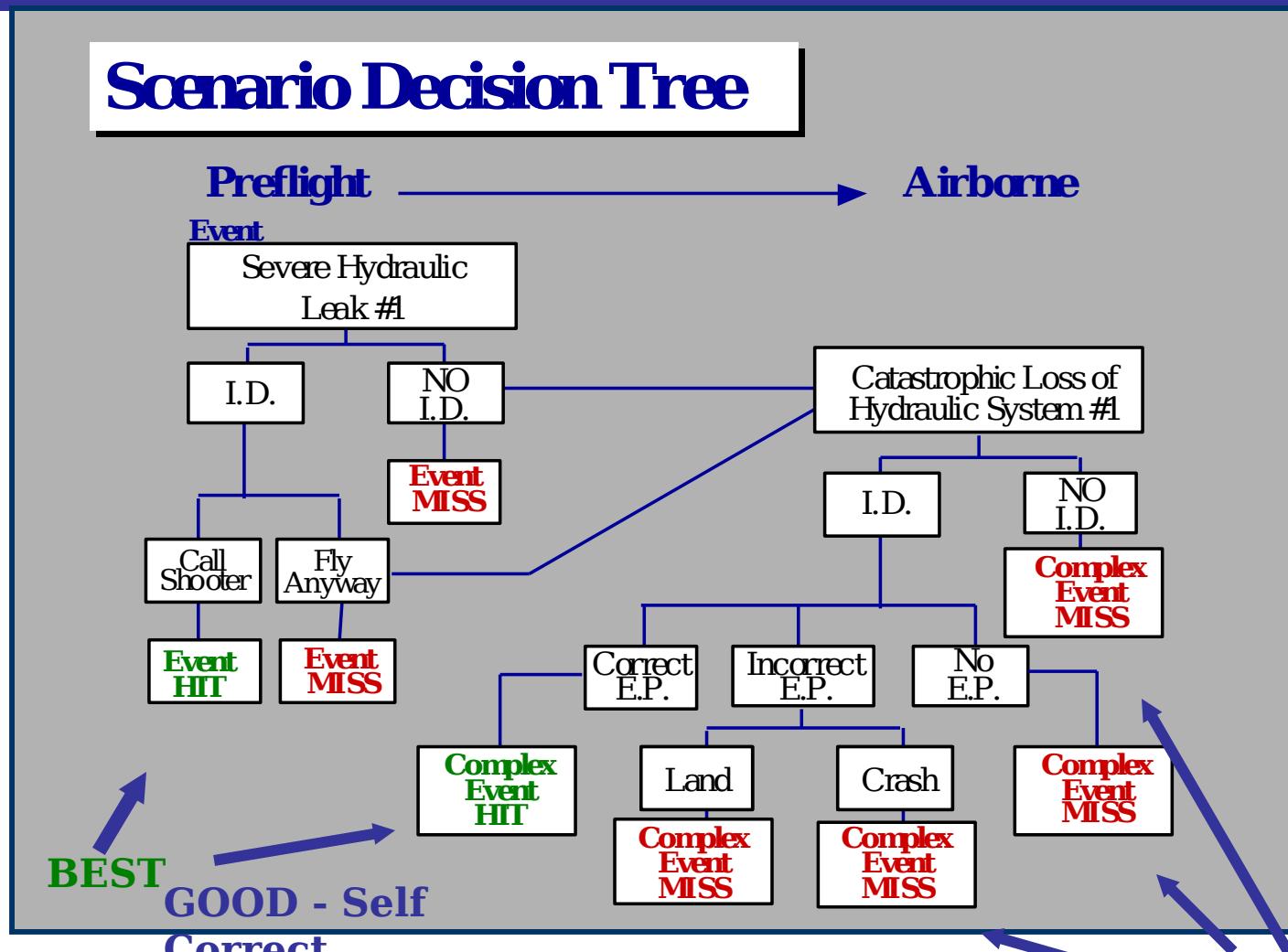
# Advanced Curriculum Support

- **Advanced training concepts: instructional techniques and technology**
  - Human Factors & performance emphasis
  - Cognitive & Skill Task analysis:
    - CAPAS to capture task/mission analysis
    - Interviews to capture experiences & thought processes
  - Integrate SA and Decision Making experiences throughout curriculum
    - Lectures, CBT, brief, debrief, evaluations
  - Design curriculum for systematic data collection

# Scenario Design/Development

- **Assess skills for effective flight performance and priority of decisions**
  - Address mishap/HAZREP causal factors, tactical and flight performance
  - Create models that correlate crew processes (MOP) to best performance (MOE).
  - Trigger performance against a measurable standard
  - Flight precision skill (stick and rudder)
  - Decision skills (ORM/CRM, NATOPS procedures, SOP, tactical procedures)

# Event-Based Scenario



# Flight Instructor Training

- **Five-day course with practical application**
  - Instructor Team (Ed Spec, CSI, Stan, Curriculum)
  - Human factors integration
  - Instructional techniques & standardization
  - Scenario development
  - Crew evaluation and feedback
  - Decision skills facilitation
- **Assessing Human Performance**
- **Use CAPAS recordings (best & worst)**
  - Practice evaluating instructional techniques and grading events

# Flight Instructor Training

- **Ongoing instructor performance data collection and feedback:**
  - Training objectives covered? (Time/quality)
  - Grading criteria used specific to event?
  - Quality of instruction, evaluation and crew performance feedback

# Aviator SA/Decision Skills Training

- ***Adaptive Decision Making*** in uncertain, time-constrained situations
- Focuses instructors & crews on critical thinking and problem solving
- Developing plans *and* solutions to realistic situations
- Instructors generate realistic scenarios geared to trigger decisions in various training events (classroom, trainer and in-flight)

***Increase versatility in thinking***

# Aviator SA/Decision Skills Training

- Applies across spectrum of training and operations
- Captures, reinforces & extends thinking skills
- Builds on experience base
  - Practice making decisions in context
  - Develop/enhance pattern recognition skills (SA)
- Facilitates crew self-evaluation
- ~~Maximizes instructor/student interaction~~  
***Optimize Decision Making Under Pressure***

# Integrated CRM Example



\* CRM = Crew Resource Management

# In Summary

- CRM training implementation plan integrating:
  - **CAPAS hardware, software and analysis**
    - Leverage advances in IT to scientifically and systematically improve training and readiness
  - **Flight Instructor and decision skills training**
    - Increase depth and broaden experience level
  - **Curriculum development training and tools**
    - Better defines MOP and MOE for more relevant training, assessment, and feedback

***CRM/ORM Becomes a Practice ...Not a Program***

# Points of Contact

- Naval Air Board Human Factors QMB,  
Training Improvements Working Group

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